

Preface

Since May 1960, when the scientist Maiman from the Hughes Research Laboratories in USA invented the fantastic laser, laser has been studied and applied extensively in various fields. Laser has been utilized in irradiation, cutting, welding, CD/DVD, printing and copying, anti-counterfeit, high-speed typesetting, measurement, communication, remote sensing, and even detecting and imaging the moon. As a consequence, laser has shown increasingly obvious influence and benefit.

Laser has been widely applied in the production and living of human. In the remote sensing detection field studied by the author, using laser to detect targets is probably the most precise method for perceiving the appearance of long-distance targets at present. This is because laser is characterized by the high brightness, high collimation, and strong coherence and can actively, real timely, and precisely acquire the three-dimensional (3D) information of the detected targets.

Target detection based on a laser imaging system is a target detecting method applying laser beams as detection media, which are radiated to illuminate targets according to certain spatial distribution law. Then, the data including time delay, intensity, waveform, phase, and polarization of laser echoes reflected from the detected targets are collected. After being processed, these data are presented in images. Afterward, feature extraction and object inversion are conducted based on the images so as to obtain the information of targets, including distance, position, reflection attribute, structure size, and motion feature. By doing so, targets are found, identified, and confirmed. This technology can provide the information, including the range images, gray images, and feature images of targets with high resolution that cannot be obtained using general imaging methods. In addition, characterized by high-resolution, high-measurement accuracy, anti-interference ability, and strong anti-shadowing ability, the laser imaging system for target detection is especially suitable for the detailed detection of targets. In international society, attention has been paid to the application of a laser imaging system in target detection: Since the mid and late 1990s, America has begun to research this technology; while at the beginning of the twentieth century, European countries have embarked on the investigation of sea-aero targets by using laser imaging. In

contrast, laser imaging is mainly studied from the perspective of laser remote sensing imaging for the earth observation in China so that the laser imaging system for target detection is relatively backward. Since the 1990s, the author has been occupied in the study of laser remote imaging and target detection. He has hosted multiple national research projects, organized, or participated in developing various spaceborne and airborne target detection systems based on laser imaging. Based on a large amount of first-hand data about laser imaging target detection acquired, the author has published a series of research papers. After integrating the data we obtained in recent years, the author writes this book, aiming to explain the basic principles and technology realization of laser imaging in target detection so as to provide helpful guidance in the field. Moreover, the author aims to provide more valuable reference to the researchers who are engaged in the study of target detection based on a laser imaging system and postgraduates who are endeavoring to participate in this field.

According to the implementation process of target detection based on a laser imaging system, this paper illustrates the basic principle, laser imaging, image processing, target detection and localization, and classification and recognition in four parts with ten chapters. The first to the third chapters comprehensively analyze the concept and mechanism of target detection based on a laser imaging system, modulation mechanism of laser, and composition and characteristics of the detection system; the fourth and fifth chapters systematically elaborate the principle and method of information acquisition, data collection, data processing, and laser image generation; the sixth to the ninth chapters focus on the technical realization of the image feature extraction, target feature extraction, target detection and location, target classification, and identification based on laser images for typical targets, while the tenth chapter discusses the source and characteristics of the errors of the target detection based on a laser imaging system.

Since the 1990s, academician Xue Yongqi, from Shanghai Institute of Technical Physics, the Chinese Academy of Science, has given elaborate guidance and support to the author's research work. Moreover, he encouraged and helped the author to write this book. Meanwhile, academicians Ling Yongshun and Gong Zhiben also provided valuable opinions and suggestions for the author's research work and this manuscript. In addition, part of the research work involved in this book was conducted in Shanghai Institute of Technical Physics, the Chinese Academy of Science. A great help has been obtained from researchers Wang Jianyu and Shu Rong as well as other people in the research group of the institute for more than a decade. Professors Lei Wuhu and Hao Shiqi, and assistant professor Zhao Nanxiang as well as other workmates and postgraduates in the research group participated in realizing part of the research work and provided helpful suggestions to this book. In writing this book, Dr. Shi Liang helped in word arrangement and typesetting; Huang Tao, Li Lei, and Xu Shilong participated in collecting data in the early period. Here, the author expresses heartfelt thanks to them in the research process. Furthermore, as numerous literatures were investigated during the writing, here, the author presents gratitude to these authors. The author also acknowledges the support of The Publishing Fund Committee of National Defense Science and

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Since this book contains new theories and technologies, some problems are remained to be further studied. Moreover, some deficiencies are inevitably presented owing to different viewpoints. Criticisms are welcome from experts and readers.

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